HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

MODEL 44425A
16 CHANNEL, ISOLATED, DIGITAL INPUT/INTERRUPT ASSEMBLY (OPTION 050)

WARNING

Only personnel with knowledge of electronic circuitry should install, re-configure, or make repairs to this instrument.

Manual Part Number 44425-90001

Microfiche Part Number 44425-90051

Printed: May 1981

HEWLETT PACKARD

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals.

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).

OR — Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.

OR — Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

DANGER — The DANGER sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which could result in injury or death to personnel even during normal operation.

WARNING — The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION — The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE: — The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual contains operating and service instructions for the Model 44425A 16 channel, Isolated, Digital Input/Interrupt Assembly (hereafter to be referred to as the Digital Input Assembly).

1-3. Applicability.

1-4. The Model 44425A is intended for use with the -hp- 3497A Data Acquisition/Control Unit and/or the 3498A Extender.

1-5. DESCRIPTION.

1-6. Card Structure.

1-7. The Digital Input card consists of sixteen optically isolated input channels. Eight of the input channels may be sensed for interrupt purposes. In addition to this, optically isolated handshaking is available to synchronize data transfer between a peripheral and the 3497A (see Figure 1-1).

1-8. Terminal Card.

1-9. The digital input terminal card has two wire connections for each of sixteen input channels, gate and flag (handshaking). Logic levels are determined by placing jumpers in designated positions that allow portions of resistive networks to attenuate the signal for the optical isolator.

1-10. Channel Allocations.

1-11. Access to a specific channel requires that the channel number is known in addition to the slot in which the digital input board is located. The five slots in the mainframe are numbered from 0 to 4. Each 3498A Extender has ten slots which may be designated for any of the decades from 10 through 80 (see Section III, Operation for the commands used with the digital input card).

NOTE

Slots 5 through 9 do not exist for digital input cards. Digital interrupt is not available in the 3498A Extender.

1-12. Channel Numbers. The sixteen channels are numbered from 0 through 15.

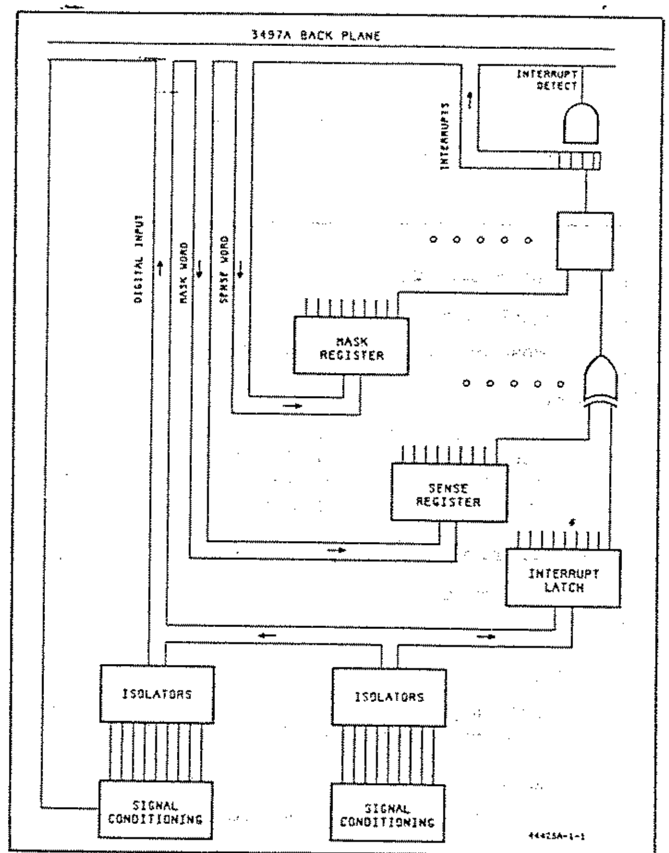


Figure 1-1. Digital Input Block Diagram.

1-13. SAFETY.

1-14. The mainframe may contain voltages as high as 357V Peak within the cabinet enclosure. Only service trained personnel are permitted access to devices within the covers of the instrument.

WARNING

Never remove or replace the Digital Input Assembly with power applied to the instrument or with power sources connected to the terminal cards.

1-15. MANUAL CHANGES.

1-16. Manual changes necessitated by circuit board revision or errata in documentation are given in a Manual Changes Supplement. To keep this manual as current as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes Supplement. The supplement is identified with the manual print date and part number.

1-17. WARRANTY.

1-18. The warranty information provided with this manual covers the Digital Input Assembly option and does not extend to any other options used with the 3497A or the 3498A.

1-19. ORDERING ADDITIONAL MANUALS.

1-20. A manual is shipped with each Model 44425A order. Additional manuals may be purchased from your local Hewlett-Packard Sales and Service Office. Specify the card model number and the -hp- Part Number as shown on the title page.

1-21. SPECIFICATIONS.

1-22. Specifications for the Digital Input Assembly are given in Table 1-1.

Table 1-1. Specifications.

Digital Input Mode (Bits 0-15)

Logic Polarity:

Positive True (Negative True is jumper selectable)

Handshaking:

Gate and flag lines are optically isolated. Gate output is open collector. Flag input is identical to input lines. Polarity of gate/flag is jumper selectable. The assembly may be configured to operate without handshaking.

Interrupt Mode (Bits 0-7)

Minimum Pulse Width:

100 microseconds

Triggering:

Each interrupt line is individually programmable for positive or negative edge triggering.

Masking:

Each interrupt line may be enabled or disabled using a programmable mask.

Multiple Interrupts:

Multiple interrupts are latched and are dealt with at a controller dependent rate.

Interrupt Timing:

The Option 050 assembly will respond to an interrupt within 1 millisecond of a programmed interrupt condition change.

Five Volt Supply:

Source up to 20 mA per assembly.

Operating Consideration:

Digital Interrupt (SRQ) is not available in the 3498A Extender.

Input Signal Characteristics:

Input Level	V_{LO}(max.)	V_{HI}(min.)	Max. Input Voltage	Min. Input Current
5V	0.8V	2.4V	30V	400 μA
12V	3.0V	7.0V	42V	1 mA
24V	6.0V	13.0V	42V	2 mA

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section provides installation instructions for the Digital Input Assembly. Also included is information concerning initial inspection, damage claims, packaging, storage, and shipment.

2-3. INITIAL INSPECTION.

2-4. The digital input board and terminal board were carefully inspected both mechanically and electrically before shipment. The assembly should be free from physical damage and be in perfect electrical order upon receipt. To confirm this, inspect the circuit boards and covers for physical damage. If any damage was incurred in transit, file a claim with the carrier. Test the electrical performance of the assembly as directed by the Performance Test (Section IV of this manual). If there is damage or deficiency, see the warranty in the front of the manual.

2-5. OPERATING ENVIRONMENT.

2-6. The digital circuit board contains components that may be damaged due to static discharge. Be aware that there is no interrupt capability for a digital assembly when installed in a 3498A Extender.

CAUTION

Verify that all power is removed from the 3497A/3498A before installing the assembly in a slot. Use clean handling techniques when removing, replacing, or re-configuring the circuit board. Handle the circuit board by the edges and do not subject the components to static discharges or excessive voltages.

2-7. Operating Temperature.

2-8. The operating temperature is from 0°C to 55°C.

WARNING

Installation and hookup should be accomplished by service trained personnel who are aware of the hazards involved.

2-9. INSTALLATION.

2-10. The Digital Input Assembly may be installed separately from the terminal board. Five slots are available for circuit board installation in the 3497A and ten slots are available in the 3498A.

2-11. Hookup and installation of terminal cards is given in Operation, Section III of this manual.

2-12. STORAGE AND SHIPMENT.

2-13. Environment.

2-14. The Digital Input Assembly may be stored or shipped within the following limits:

Temperature........... −40°C to +75°C
Humidity...............Up to 95% R.H.

The assembly should be protected from temperature extremes which may lead to condensation on the circuit board or circuit board components.

2-15. Packaging.

2-16. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the assembly is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, revision letter, and board serial number.

2-17. Other Packaging. The following instructions should be used for repacking with commercially available materials:

a. Wrap the assembly in a material which will not subject the circuit board components to static discharge.

b. Use a strong shipping container. A shipping container should be so constructed that the circuit board and circuit board components will not sustain damage in transit.

c. Seal the shipping container securely.

d. Mark the container as indicated in Original Packaging.

WARNING

The Model 44425A is not intended for outdoor use. Do not expose it to rain or other excessive moisture.

c. Use a strong shipping container. A shipping container ... ensure that the circuit board and circuit board components will not sustain damage in transit.

d. Seal the shipping container securely.

e. Mark the container as indicated in Original Packaging.

WARNING

The Model 44435A is not intended for outdoor use. Do not expose it to rain or other excessive moisture.

2-7. Operating Temperature

2-8. The operating temperature ... of 0 to 50 C

WARNING

Installation and hookup should be accomplished by service-trained personnel who are aware of the hazards involved.

2-9. INSTALLATION

2-10. The Digital Input Assembly may be installed

WARNING

Only personnel with knowledge of electronic circuitry should install, re-configure, or make repairs to this instrument.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. The Operating Section contains those instructions and procedures which correspond to the operation of the Digital Input Assembly. Also included are hookup, reconfiguration procedures, and information concerning the terminal card.

3-3. OPERATING COMMANDS.

3-4. The instructions which correspond to Digital Input Assembly are given in Table 3-1. Note that these instructions are also listed in the Command Quick Reference under the Digital grouping (see Interfacing, Commands, and Syntax Structure in the main Operating and Service Manual).

Table 3-1. Digital Commands.

Mnemonic	Function	Definition
DRn*	Digital Read (slot)	n=Ø to 89
DIn*	Digital Interrupt Status (slot)	n=Ø to 4
DSn1,n2	Digital Interrupt Sense (slot, octal)	n1=Ø to 4 n2=Ø to 377 bit position = positive transition
DEn1,n2	Digital Interrupt Enable (slot, octal)	n1=Ø to 4 n2=Ø to 377 bit position = input bit enabled.
DVn	Digital View (slot)	n=Ø to 89
DLn*	Digital Load (slot)	n=Ø to 89
SI	(see Mainframe Functional Area)	

*Changes 3497A output to this function.

3-5. Digital Read.

3-6. To read the output of a digital card on a continuous basis, send "DRn" over the remote interface. The parameter "n" is a slot number from Ø to 89. Data will be loaded into the output buffer ready for transfer to the controller. To transfer the data, perform a read operation. Data transferred will be the octal equivalent of the high true input to the card. The octal numbers, comprised of six digits, are ASCII characters. The maximum read rate of a digital card is typically 400Hz.

3-7. Digital Interrupt Status.

3-8. The interrupt status of each of the five mainframe slots may be checked by sending the "DIn" command over the remote interface. The parameter "n" is a slot number from Ø to 4. The interrupt data for that slot will be loaded into the output buffer. Reading from the 3497A results in the transmission, to the controller, of three octal digits (000 to 377) that indicate the value of the interrupt bits. If bit 3 received an interrupt, the value returned after the 3497A is read by the controller would be 10_8 (00 001 000).

3-9. Digital Interrupt Sense.

3-10. The interrupt sense is the direction of signal transition in a bit position (channel). When "DSn1,n2" is sent over the remote interface, "n1" denotes the slot (Ø to 4) and "n2" denotes the channel for which positive transitions will be sensed. The parameter "n2" is an octal number (sent as ASCII characters) in the range from Ø to 377. For example, to sense the positive transitions on channel CH6 in slot 2, send "DS2,1ØØ". Note that n2 is derived in octal (01 000 000). A direct correlation to this is that all channels not designated for positive transitions will be sensed for negative transitions. In this case, sending "DS2,Ø" will enable negative sense on all eight bits.

3-11. Digital Interrupt Enable.

3-12. Any combination of the eight interrupt channels may be selected to set the SRQ bit in the 3497A mainframe. This is accomplished by sending the "DEn1,n2" command over the remote interface. The parameter "n1" is the slot number; parameter "n2" is an octal number (Ø to 377) that indicates the interrupt channels. For example, to enable channels Ø, 1, and 2 in slot 3, send "DE3,7". The number for "n2" is derived by figuring the bit positions in octal (00 000 111) $111 = 7_8$. If "n2" equals Ø, all channels are disabled.

3-13. Digital View.

3-14. Digital view allows the display (front panel option required) to be dedicated to a slot. To use digital view, send "DVn" over the remote interface. The parameter "n" (Ø to 89) is the slot number. Digital view may also be initiated on the front panel when the instrument is in remote. The command "DV" without a parameter, disables the function. Note that the Digital View command does not effect the sequence of operations in the 3497A.

3-15. Digital Load.

3-16. Digital load provides the same information as

digital read (DR) with the exception that only one reading is produced each time the command is executed. To execute digital load, send "DLn" over the remote interface. The parameter "n" (Ø to 89) is the slot number.

3-17. USING THE DIGITAL INPUT TERMINAL CARD.

3-18. Each digital channel requires two connections to complete the circuit to the optical isolator input. This allows each channel to be isolated from the other input channels unless common connections are made (see Digital Input Board Modifications). Jumpers enable the selection of +5V (factory set), +12V, and +24V logic levels (see Figure 3-1). The logic level network has protection in case of reversed connections (see Figure 3-2). Note that the "FLAG" input is similar to a channel input. The "GATE" output is an open collector device (user must supply pull-up source voltage). Note that the "GATE" output is zener limited to 30V to protect the device from operating at excessive power levels.

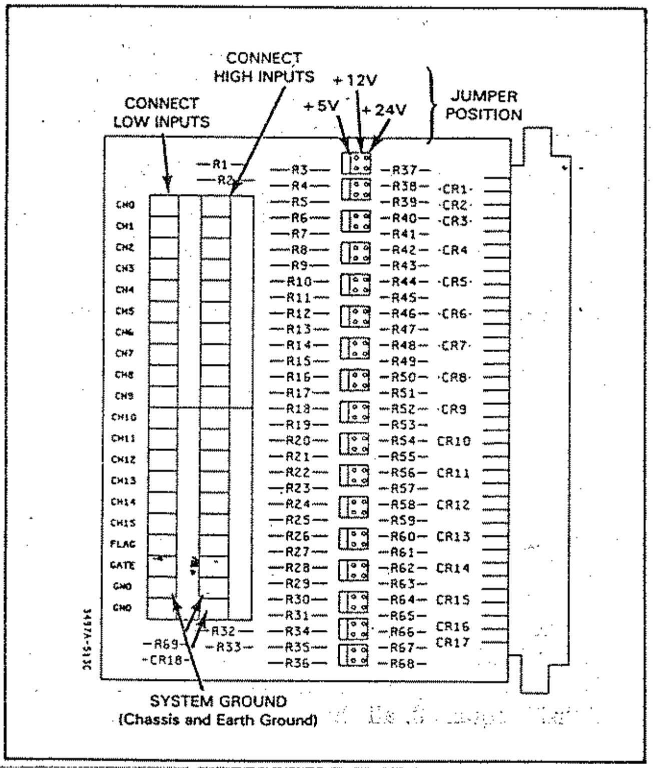


Figure 3-1. Terminal Board Connections.

3-19. Wire Routing In The Terminal Card Holder.

3-20. To connect the inputs to the terminals, remove four screws that retain the terminal card cover. Route the wires through the labyrinth in the card holder and out the port at the bottom; this provides strain relief for the terminals (see Figure 3-3). When finished, replace the card cover.

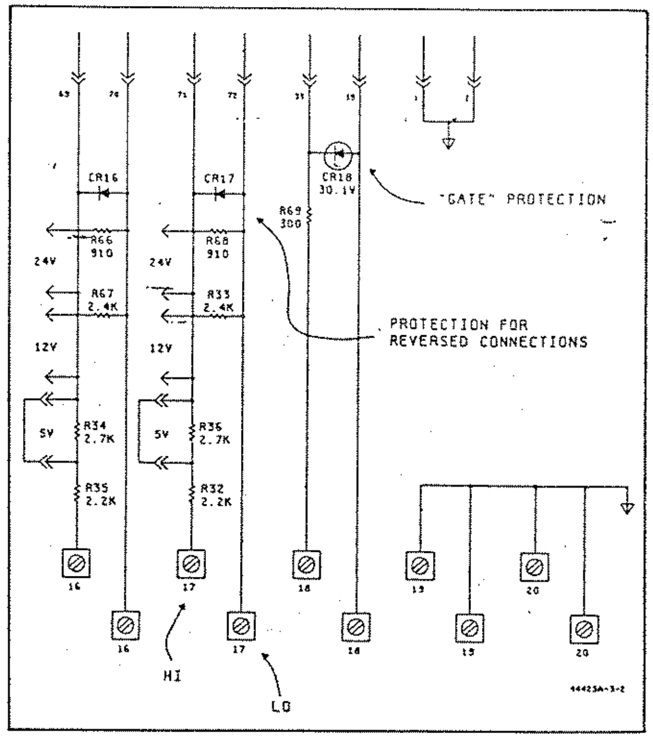


Figure 3-2. Digital Input Protection.

3-21. OPERATING CONSIDERATIONS.

3-22. Pulse Width For Interrupt.

3-23. To establish an interrupt on one or more of the eight designated channels, the pulse width of the input signal must be greater than 100 microseconds.

NOTE

In many cases it is desirable to use isolation on the digital inputs. This will reduce the possibility that spurious signals will trigger an interrupt.

3-24. Handshaking.

3-25. When shipped from the factory, handshaking on the digital input board is disabled. This requires that the controller be programmed to read any fluctuating input data at the appropriate time to assure that the data is valid. Handshaking is used to verify that the 3497A responds to each data transmission, thereby synchronizing the data source with the digital input. To enable handshaking, set the jumper on the digital input board to "HS".

3-26. **Handshake Signals.** The 3497A begins the handshake sequence by signaling a "READY" condition on

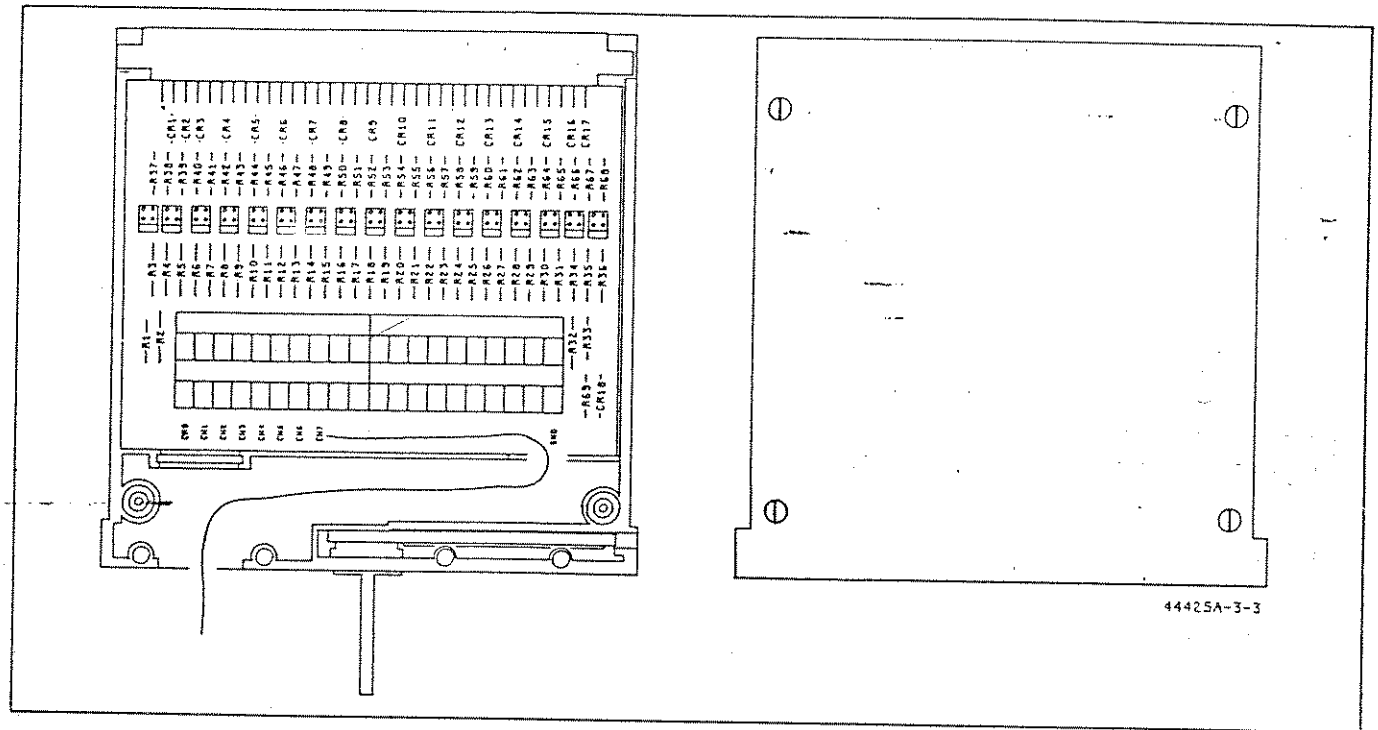


Figure 3-3. Wire Routing In The Terminal Card Holder.

the "GATE" output line. This may be the result of a digital read "DRn" or a digital load "DLn" command. the data source may then place data on the input lines and signal that the data is valid and stable by toggling the "FLAG" line. The 3497A immediately responds by setting the "GATE" line to "BUSY". The "BUSY" mode will continue until the data is removed from the digital input card buffers and transferred to the controller (example signals are given in Figure 3-4).

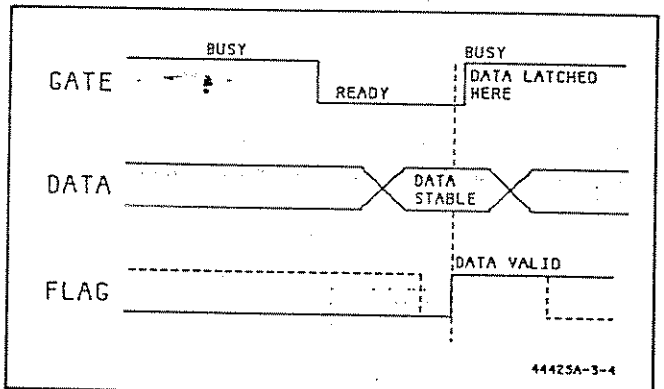


Figure 3-4. Factory Set Handshake Signals.

3-27. EXAMPLE PROGRAMS.

3-28. Reading Digital Data.

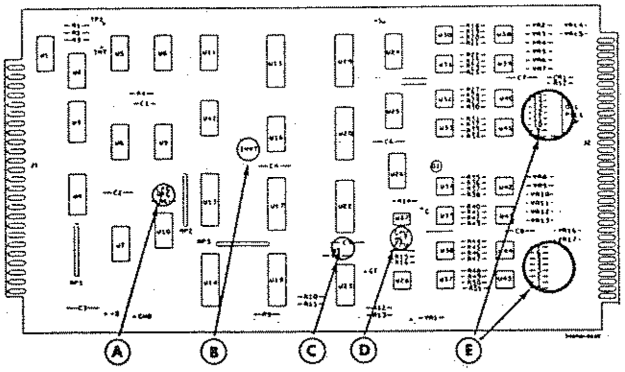
3-29. The following program reads the digital data in slot 4 and prints the results.

```
10 CLEAR 709
20 OUTPUT 709; "DR4"
30 ENTER 709; A
40 PRINT A
50 END
```

3-30. Using Digital Interrupt.

3-31. Using digital interrupt requires that the digital input card be preset to respond to the appropriate channels and the mainframe SRQ register be masked to enable SRQ for digital interrupt. The following program sets SRQ for a positive transition on channels 5 and 2 in slot 3.

```
10 CLEAR 709
20 ON INT #7,15 GOSUB Interrupt
30 CONTROL MASK 7; 128
40 ENABLE
50 OUTPUT 709; "DS3,44DE3,44"—— Set sense; set enable
60 OUTPUT 709;"SE2" ——————— Set SRQ register for
                                digital interrupt.
70 ! Main Program Starts Here
80 GOTO 70
90 END
100 Interrupt: STATUS 709;S
110 IF S#2 THEN 150
120 OUTPUT 709;"DI3"
130 ENTER 709; T
140 PRINT "INTERRUPT DATA",T
150 RETURN
```



Function	Location	Description
LFG	a	Flag sense on high to low transition
HFG	a	Flag sense on low to high transition (Factory setting)
INVT	b	Inverts input data logic to low true (applies to DRn and DLn commands)
HS	c	Enables handshake
GPU	d	Gate Pullup. Install 2Kohm resistor if data source does not have pull up.*
HGT	d	High Gate. "BUSY" = high "READY" = low
FPU	d	Flag Pullup. Install 2Kohm resistor if data source does not have pull up.*
LGT	d	Low Gate. "BUSY" = low "READY" = high (factory setting)
OC Pull Up	e	Open Collector Pull Ups. Install 2Kohm resistors if data source has open collector outputs.*

*System grounds must be connected between data source and 3497A.

Figure 3-5. Digital Input Board Modifications.

3-32. Digital Input Modifications.

3-33. The digital input board is shipped from the factory in a defined configuration as noted below. However, further modifications may be made to the circuit board to enhance its utility. Figure 3-5 describes portions of the circuit board which are subject to reconfiguration.

3-34. Modifications for Contact Closure To Ground. One way to configure the digital input board for contact closure to ground requires that the two system grounds be connected together. In addition to this, a pull up (2 Kohms) is added to the OC PULL UP block for each channel used. A diagram describing the hookup for one channel is given in Figure 3-6.

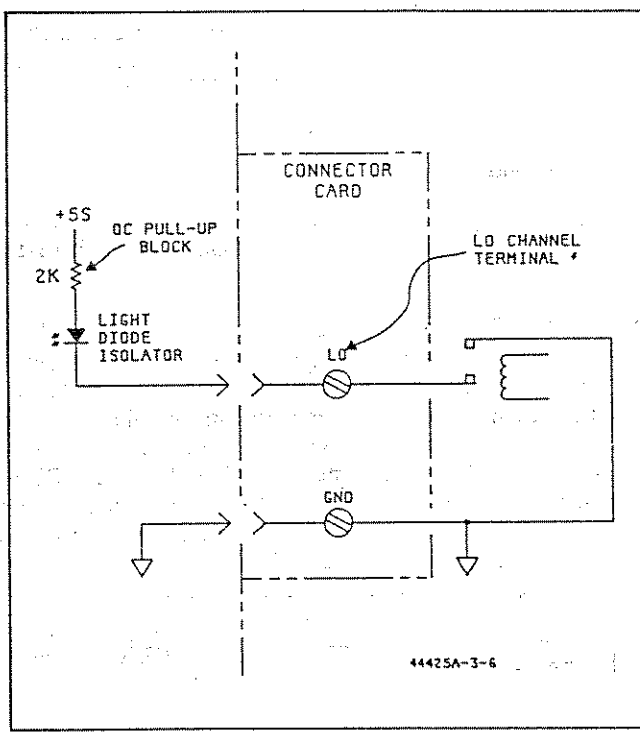


Figure 3-6. Configuration For Contact Closure To Ground.